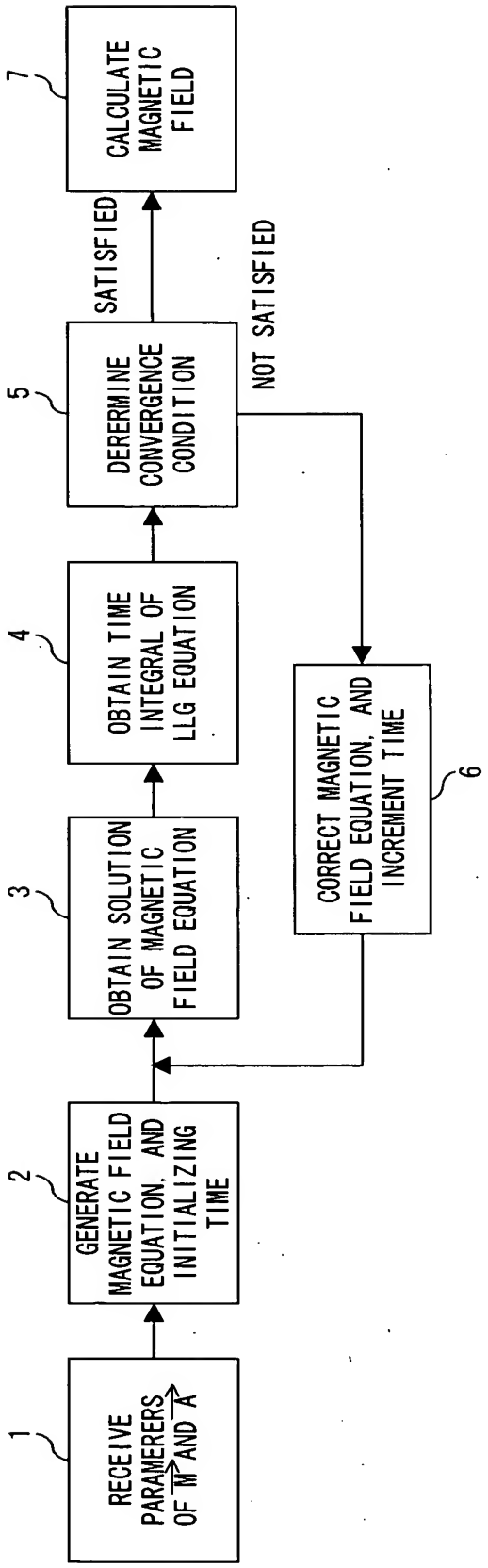
1
RECEIVE PARAMERERS OF M AND A
2
GENERATE MAGNETIC FIELD EQUATION, AND INITIALIZING TIME
3
OBTAIN SOLUTION OF MAGNETIC FIELD EQUATION
4
OBTAIN TIME INTEGRAL OF LLG EQUATION
5
DERERMINE CONVERGENCE CONDITION
SATISFIED
NOT SATISFIED
6
CORRECT MAGNETIC FIELD EQUATION, AND INCREMENT TIME
7
CALCULATE MAGNETIC FIELD

FIG. 1

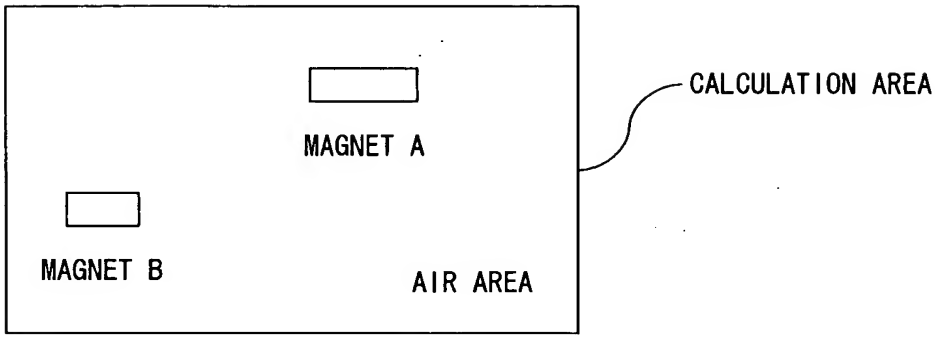

FIG. 2

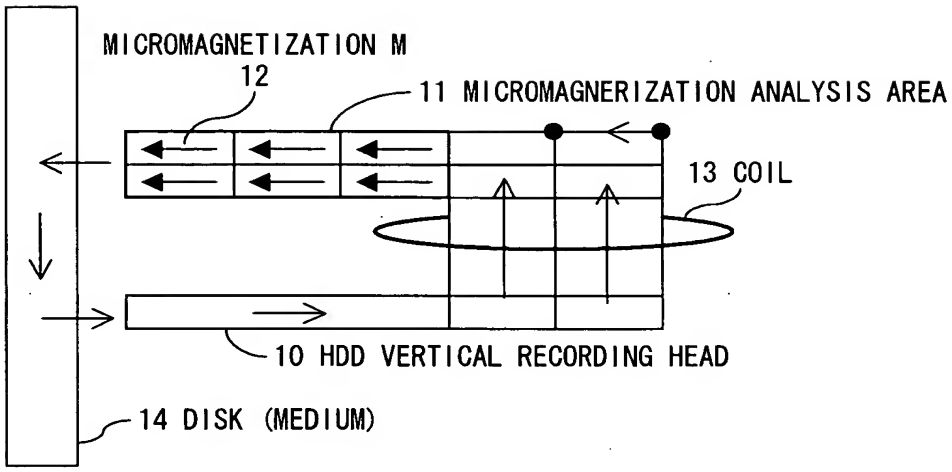
MICROMAGNETIZATION M
12
11 MICROMAGNERIZATION ANALYSIS AREA
13 COIL
10 HDD VERTICAL RECORDING HEAD
14 DISK (MEDIUM)

FIG. 3

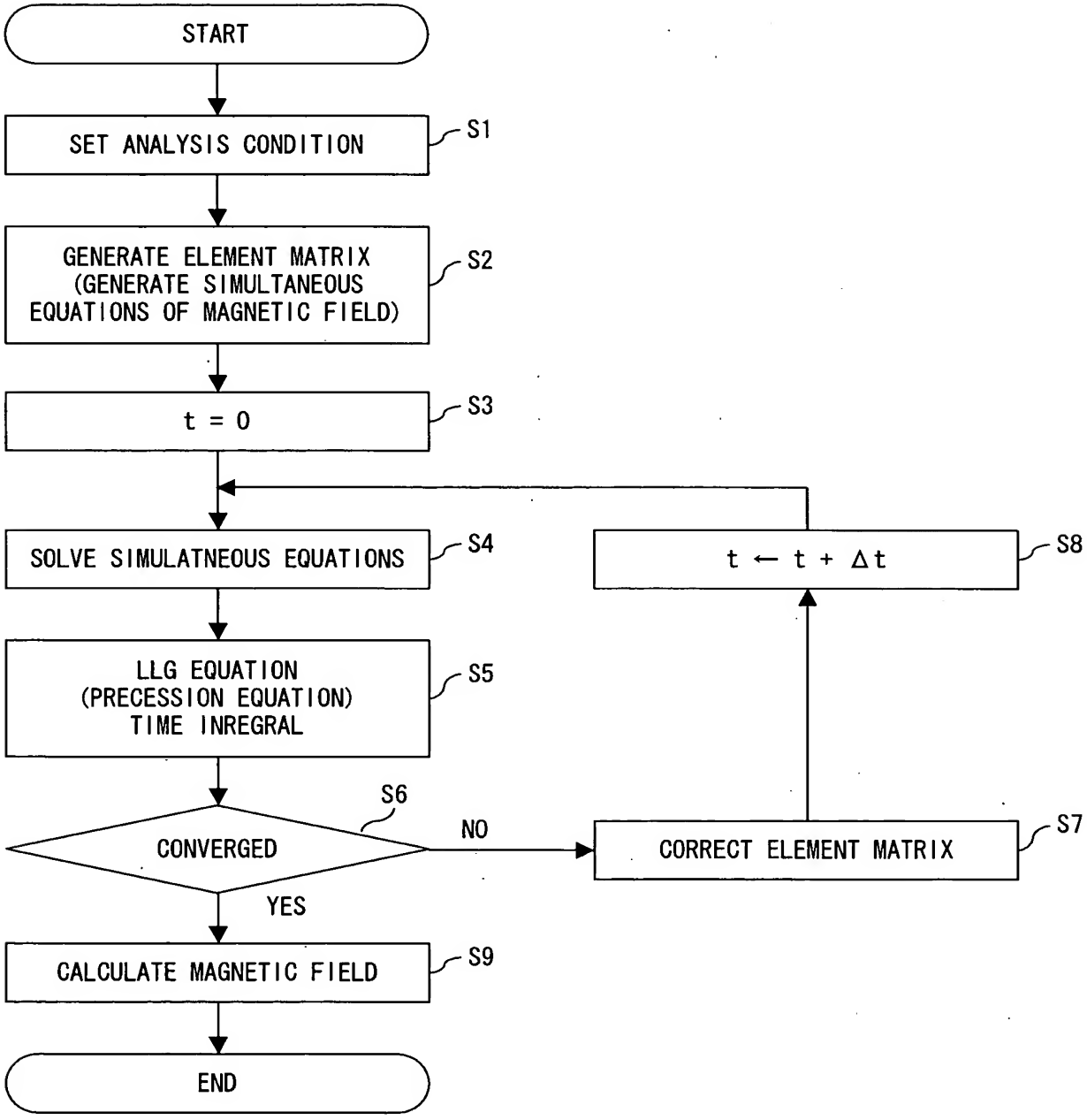
START
SET ANALYSIS CONDITION
S1
GENERATE ELEMENT MATRIX (GENERATE SIMULTANEOUS EQUATIONS OF MAGNETIC FIELD)
S2
t = 0
S3
SOLVE SIMULATNEOUS EQUATIONS
S4
LLG EQUATION (PRECESSION EQUATION) TIME INREGRAL
S5
S6
CONVERGED
NO
YES
CORRECT ELEMENT MATRIX
S7
t ← t + Δt
S8
CALCULATE MAGNETIC FIELD
S9
END

FIG. 4

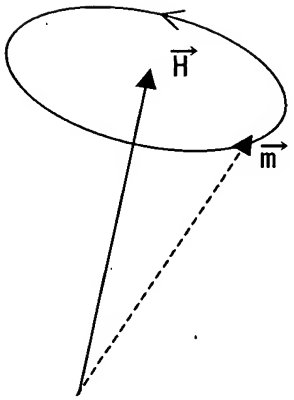

FIG. 5

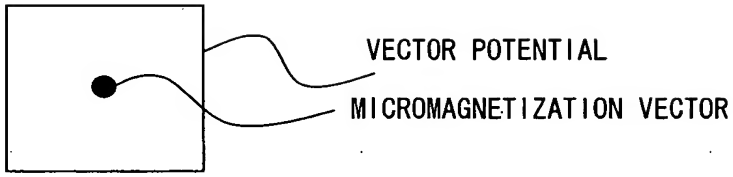

FIG. 6

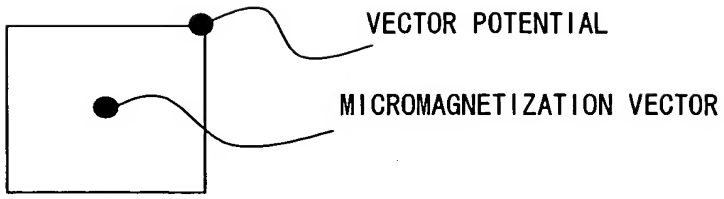

FIG. 7

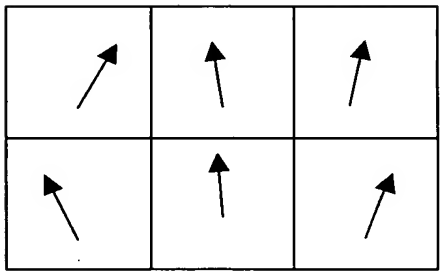

FIG. 8

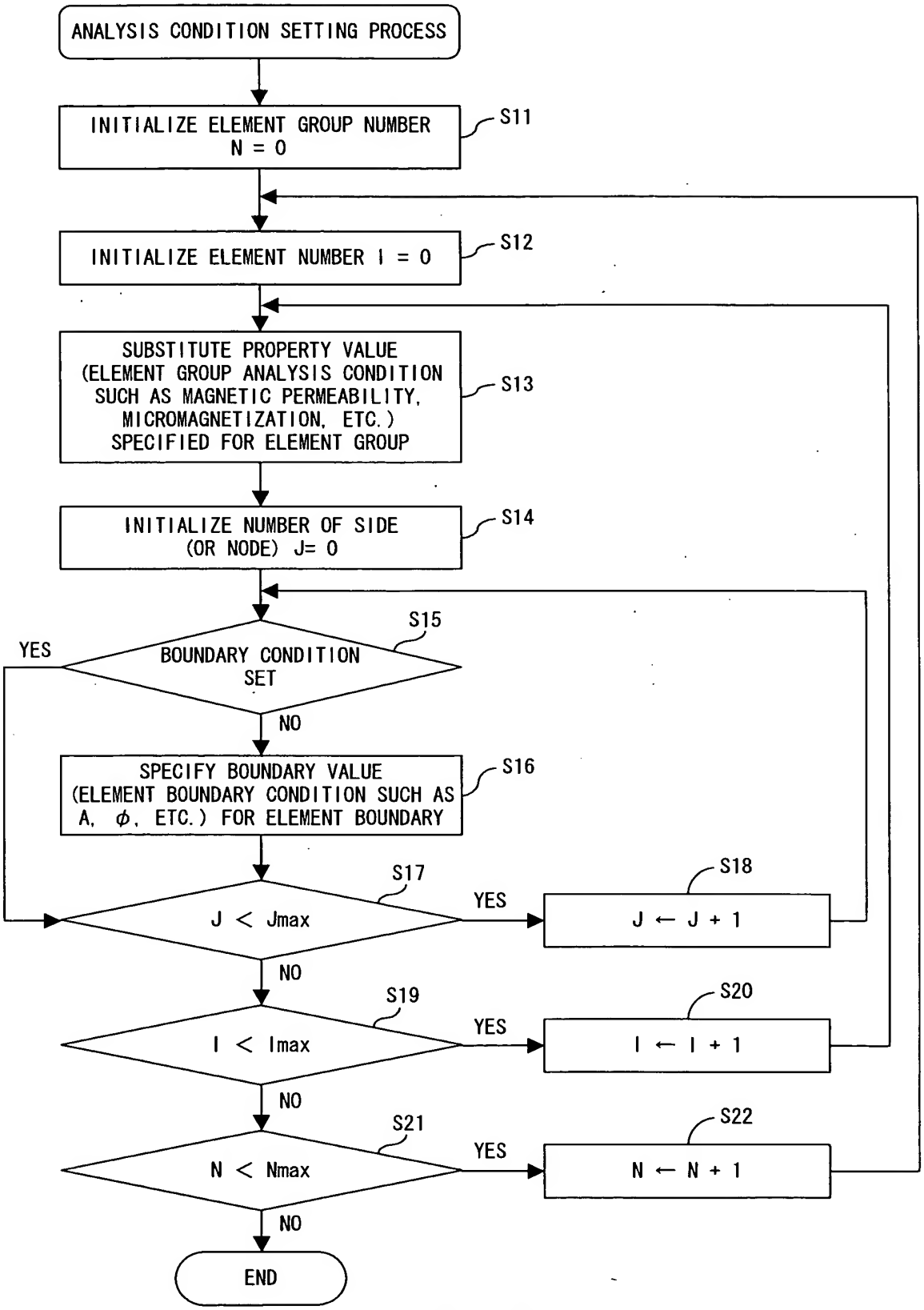
ANALYSIS CONDITION SETTING PROCESS
INITIALIZE ELEMENT GROUP NUMBER N = 0
S11
INITIALIZE ELEMENT NUMBER I = 0
S12
SUBSTITUTE PROPERTY VALUE (ELEMENT GROUP ANALYSIS CONDITION SUCH AS MAGNETIC PERMEABILITY, MICROMAGNETIZATION, ETC.) SPECIFIED FOR ELEMENT GROUP
S13
INITIALIZE NUMBER OF SIDE (OR NODE) J= 0
S14
S15
BOUNDARY CONDITION SET
YES
NO
SPECIFY BOUNDARY VALUE (ELEMENT BOUNDARY CONDITION SUCH AS A, φ, ETC.) FOR ELEMENT BOUNDARY
S16
S17
J < Jmax
YES
S18
J ← J + 1
NO
S19
I < Imax
YES
S20
I ← I + 1
NO
S21
N < Nmax
YES
S22
N ← N + 1
NO
END

FIG. 9

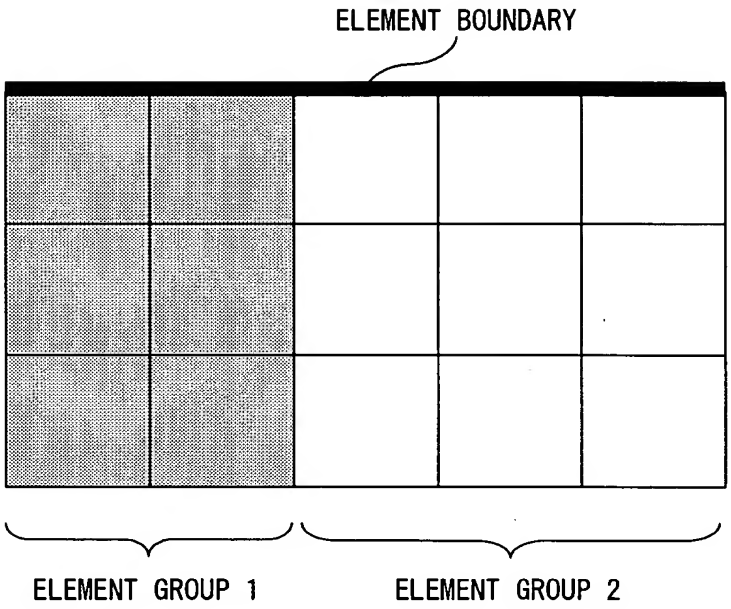

FIG. 10

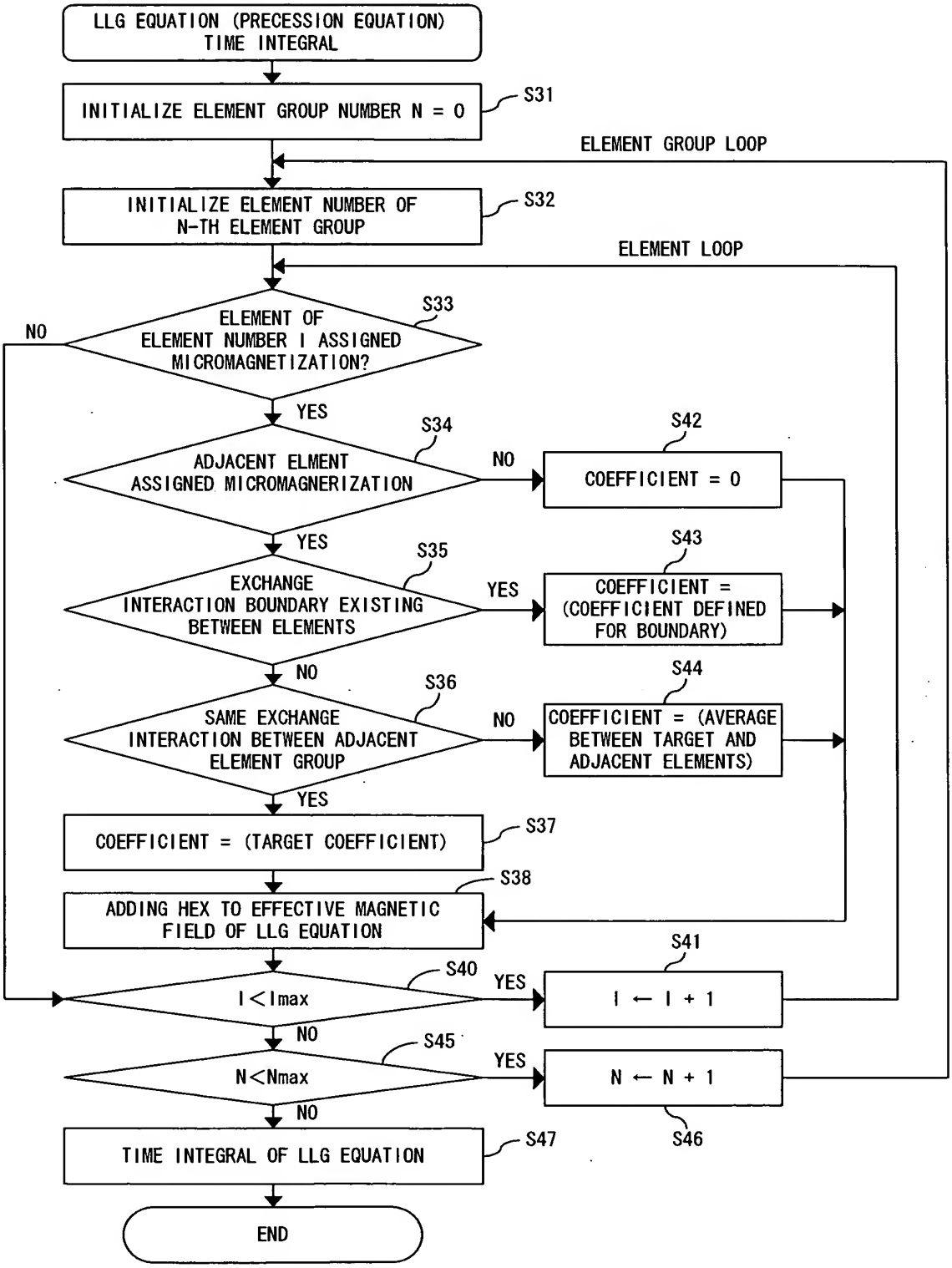
LLG EQUATION (PRECESSION EQUATION) TIME INTEGRAL
INITIALIZE ELEMENT GROUP NUMBER N = 0
S31
ELEMENT GROUP LOOP
INITIALIZE ELEMENT NUMBER OF N-TH ELEMENT GROUP
S32
ELEMENT LOOP
ELEMENT OF ELEMENT NUMBER I ASSIGNED MICROMAGNETIZATION?
S33
NO
YES
ADJACENT ELMENT ASSIGNED MICROMAGNERIZATION
S34
NO
S42
COEFFICIENT = 0
YES
EXCHANGE INTERACTION BOUNDARY EXISTING BETWEEN ELEMENTS
S35
YES
S43
COEFFICIENT = (COEFFICIENT DEFINED FOR BOUNDARY)
NO
SAME EXCHANGE INTERACTION BETWEEN ADJACENT ELEMENT GROUP
S36
NO
S44
COEFFICIENT = (AVERAGE BETWEEN TARGET AND ADJACENT ELEMENTS)
YES
COEFFICIENT = (TARGET COEFFICIENT)
S37
ADDING HEX TO EFFECTIVE MAGNETIC FIELD OF LLG EQUATION
S38
I<Imax
S40
YES
S41
I ← I + 1
NO
N<Nmax
S45
YES
N ← N + 1
S46
NO
TIME INTEGRAL OF LLG EQUATION
S47
END

FIG. 11

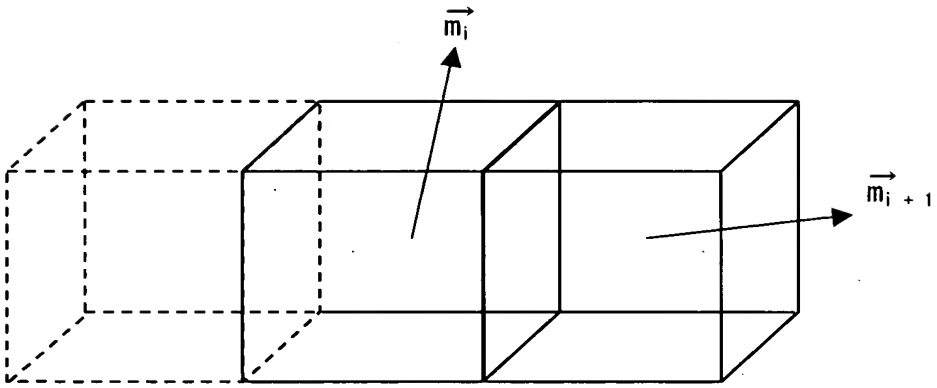

FIG. 12

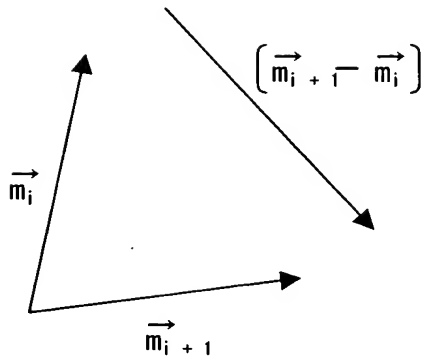

FIG. 13

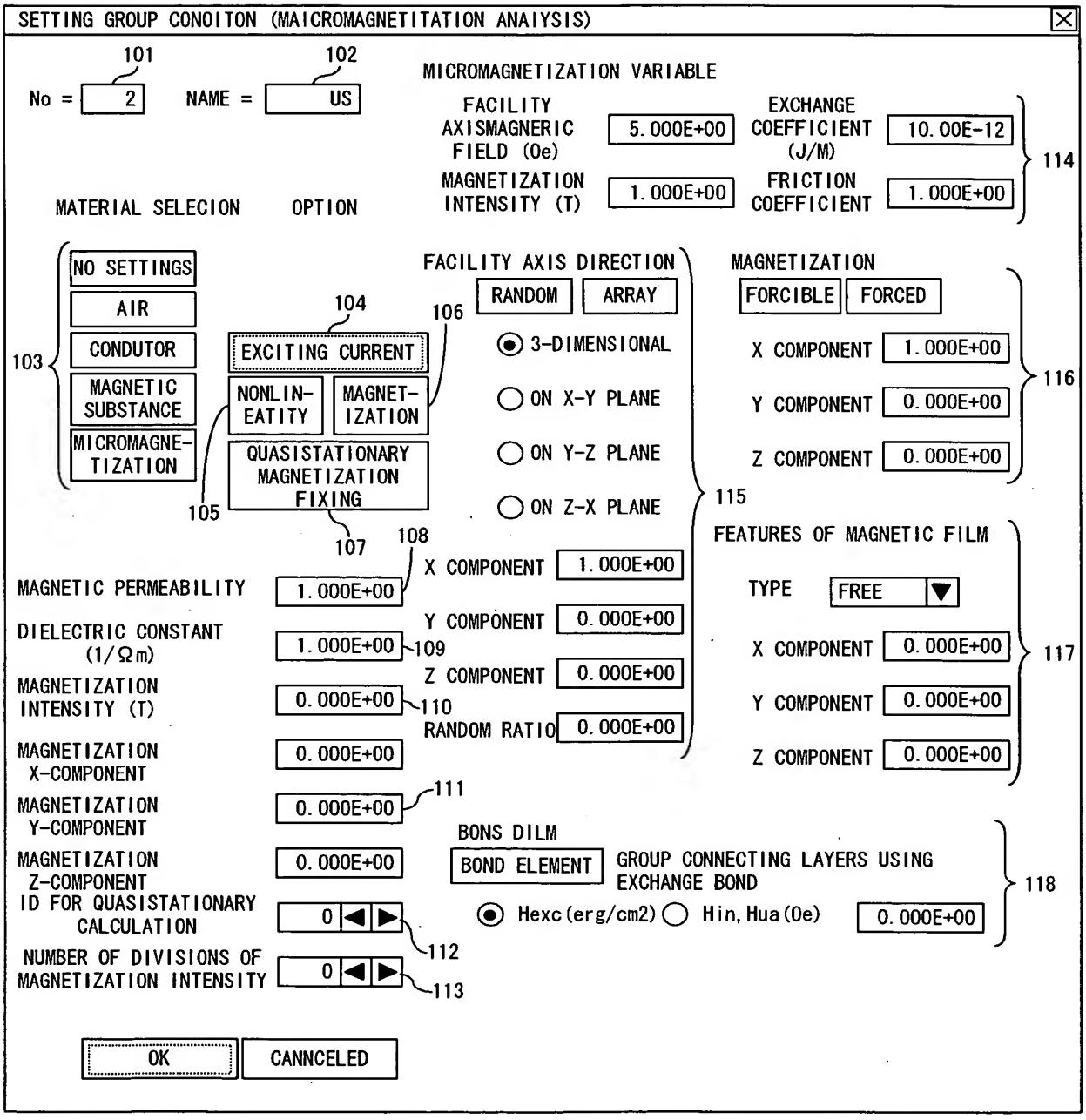
SETTING GROUP CONOITON (MAICROMAGNETITATION ANAIYSIS)
101
102
No = 2
NAME = US
MICROMAGNETIZATION VARIABLE
FACILITY AXISMAGNERIC FIELD (Oe)
5.000E+00
EXCHANGE COEFFICIENT (J/M)
10.00E-12
MAGNETIZATION INTENSITY (T)
1.000E+00
FRICTION COEFFICIENT
1.000E+00
114
MATERIAL SELECION
OPTION
NO SETTINGS
AIR
CONDUTOR
MAGNETIC SUBSTANCE
MICROMAGNE-TIZATION
103
104
EXCITING CURRENT
NONLIN-EATITY
MAGNET-IZATION
106
QUASISTATIONARY MAGNETIZATION FIXING
105
107
FACILITY AXIS DIRECTION
RANDOM
ARRAY
3-DIMENSIONAL
ON X-Y PLANE
ON Y-Z PLANE
ON Z-X PLANE
115
MAGNETIZATION
FORCIBLE
FORCED
X COMPONENT 1.000E+00
Y COMPONENT 0.000E+00
Z COMPONENT 0.000E+00
116
108
MAGNETIC PERMEABILITY
1.000E+00
X COMPONENT 1.000E+00
Y COMPONENT 0.000E+00
Z COMPONENT 0.000E+00
RANDOM RATIO 0.000E+00
DIELECTRIC CONSTANT (1/Ωm)
1.000E+00
109
MAGNETIZATION INTENSITY (T)
0.000E+00
110
MAGNETIZATION X-COMPONENT
0.000E+00
MAGNETIZATION Y-COMPONENT
0.000E+00
111
MAGNETIZATION Z-COMPONENT
0.000E+00
FEATURES OF MAGNETIC FILM
TYPE FREE
X COMPONENT 0.000E+00
Y COMPONENT 0.000E+00
Z COMPONENT 0.000E+00
117
BONS DILM
BOND ELEMENT
GROUP CONNECTING LAYERS USING EXCHANGE BOND
Hexc (erg/cm2)
Hin, Hua (Oe)
0.000E+00
118
ID FOR QUASISTATIONARY CALCULATION
0
112
NUMBER OF DIVISIONS OF MAGNETIZATION INTENSITY
0
113
OK
CANNCELED

FIG. 14

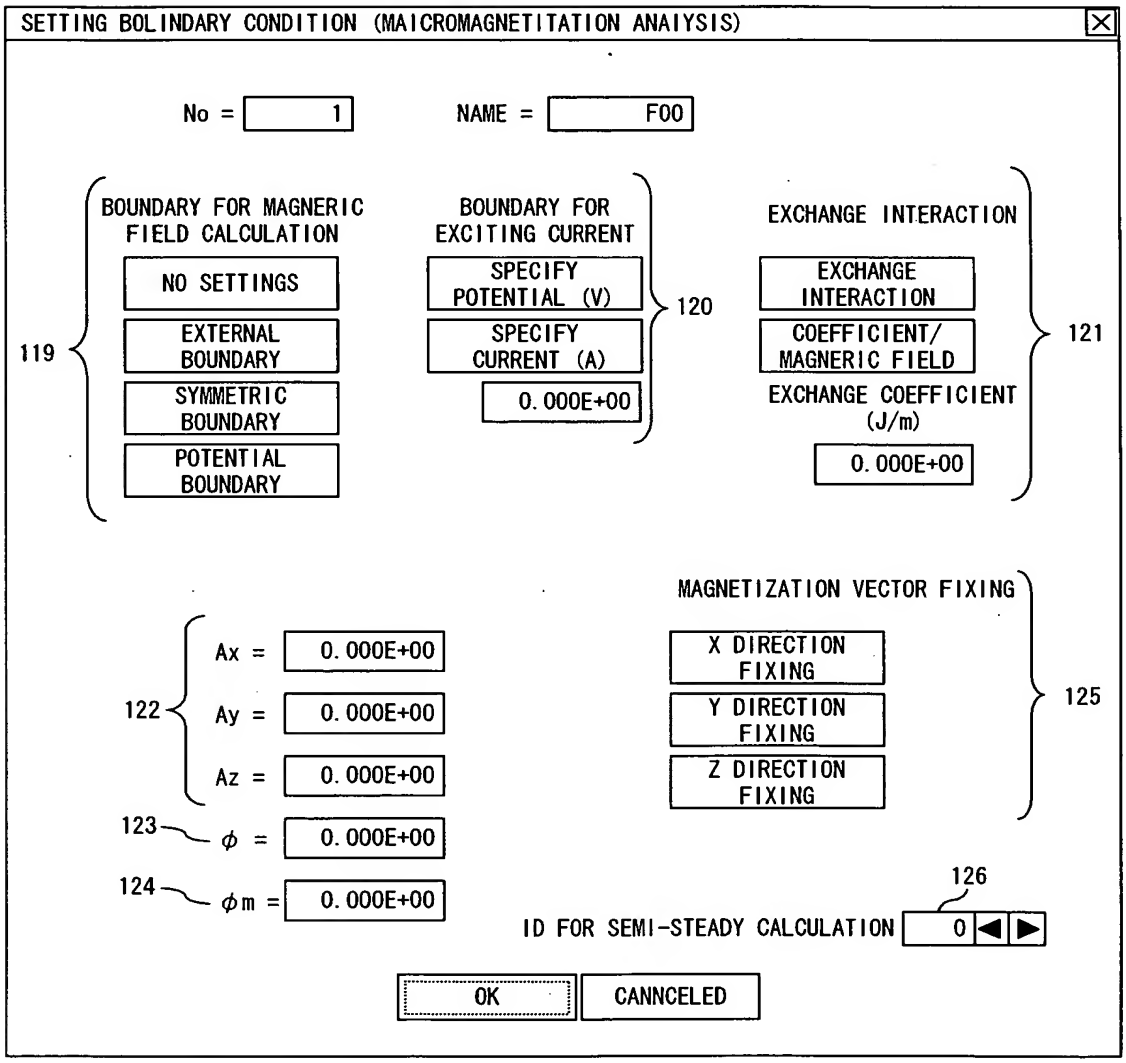
SETTING BOLINDARY CONDITION (MAICROMAGNETITATION ANAIYSIS)
No = 1
NAME = F00
BOUNDARY FOR MAGNERIC FIELD CALCULATION
NO SETTINGS
EXTERNAL BOUNDARY
SYMMETRIC BOUNDARY
POTENTIAL BOUNDARY
119
BOUNDARY FOR EXCITING CURRENT
SPECIFY POTENTIAL (V)
SPECIFY CURRENT (A)
0.000E+00
120
EXCHANGE INTERACTION
EXCHANGE INTERACTION
COEFFICIENT/ MAGNERIC FIELD
EXCHANGE COEFFICIENT (J/m)
0.000E+00
121
MAGNETIZATION VECTOR FIXING
X DIRECTION FIXING
Y DIRECTION FIXING
Z DIRECTION FIXING
125
122
Ax = 0.000E+00
Ay = 0.000E+00
Az = 0.000E+00
123
φ = 0.000E+00
124
φm = 0.000E+00
126
ID FOR SEMI-STEADY CALCULATION 0
OK
CANNCELED

FIG. 15

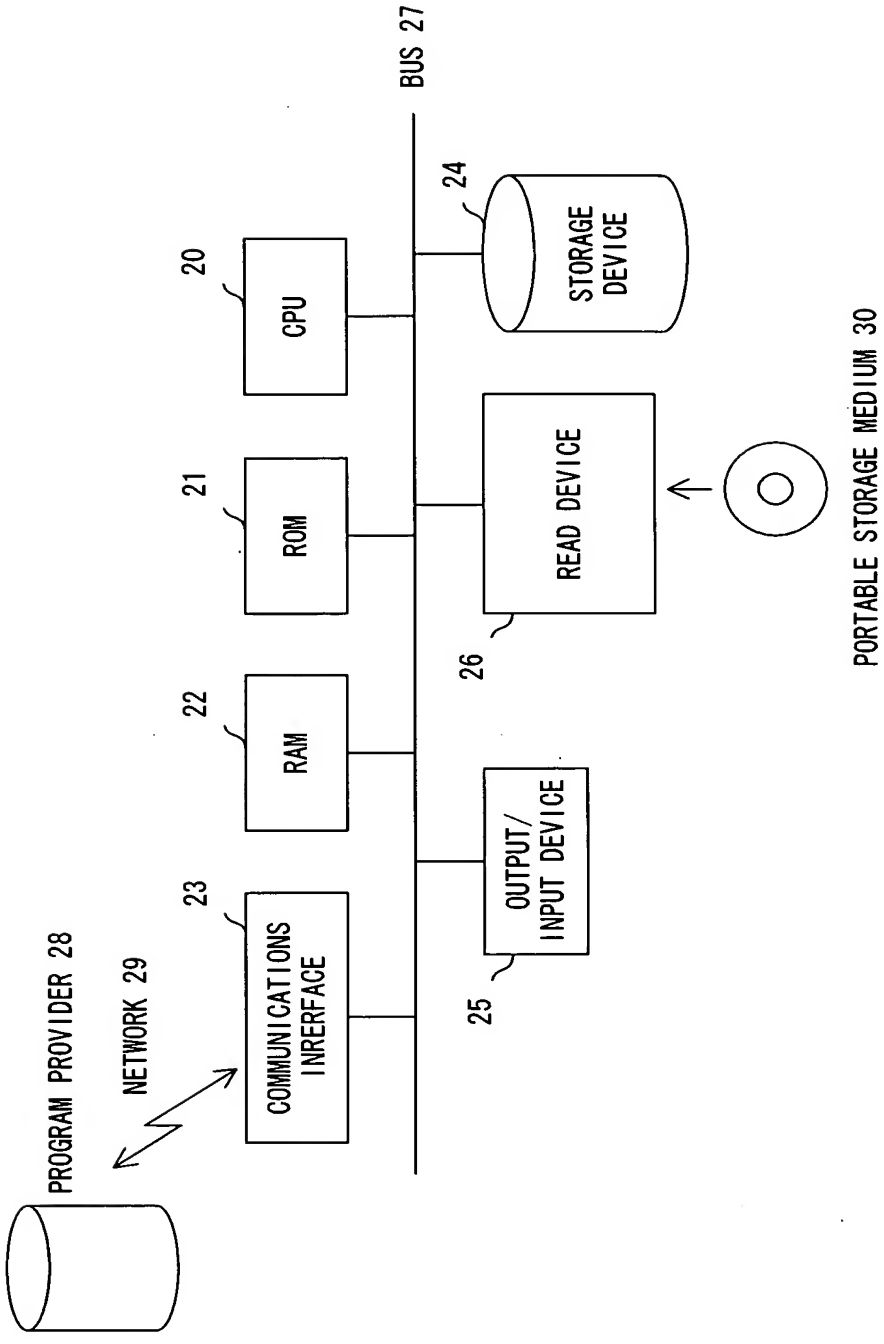
BUS 27
20
CPU
21
ROM
22
RAM
23
COMMUNICATIONS INRERFACE
24
STORAGE DEVICE
25
OUTPUT/ INPUT DEVICE
26
READ DEVICE
PORTABLE STORAGE MEDIUM 30
NETWORK 29
PROGRAM PROVIDER 28

FIG. 16